# Oklahoma regulators looking at new earthquake protocols for energy companies

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Oklahoma regulators for the first time are expected to release industry guidelines on the small number of earthquakes possibly linked to hydraulic fracturing, a departure from their recent focus on the connections to wastewater disposal wells used in oil and gas development.

The hydraulic fracturing plan is expected to be released along with tougher, new directives on wastewater disposal wells linked to seismic activity near Cushing and Pawnee, Corporation Commission spokesman Matt Skinner confirmed to *The Oklahoman* on Thursday.

Recent earthquakes south and west of the Oklahoma City area prompted scientists and regulators to look again at possible links to hydraulic fracturing. Those areas fall outside two regional wastewater reduction plans for disposal wells unveiled earlier this year by the Oklahoma Corporation Commission.

Four earthquakes ranging from magnitude 3.4 to 3.0 struck south and southwest of Blanchard this summer. In Canadian County, three earthquakes of magnitude 3.3 and 3.1 hit south of Calumet in November. Both areas are in the fast-growing SCOOP and STACK plays.

"This is part of a continuous, ever-evolving approach when it comes to seismicity," Skinner told *The Oklahoman*. "The bulk of our concern is obviously up in the main earthquake areas like Cushing and Pawnee. But we have been providing data and working with the Oklahoma Geological Survey on the issue of hydraulic fracturing and seismicity. It is something we hope to complete work on soon, but quite frankly, our highest priority is up in the main earthquake area."

Skinner said regulators want to take a proactive approach to the possibility of earthquakes related to hydraulic fracturing in the SCOOP and STACK areas of the state.

The enhanced regulatory response on hydraulic fracturing comes after Oklahoma officials, scientists and industry representatives have worked for the past couple of years to keep the seismic focus on wastewater disposal wells. A growing body of scientific research has linked the increase in seismicity in Oklahoma to higher volumes of wastewater disposal into the deep Arbuckle formation.

Although "fracking" has become a catchall term for any energy development, the process itself is different from the practice of disposing of the produced wastewater that comes up with oil and natural gas. Hydraulic fracturing is used to enhance production after a well has been



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drilled and involves injecting water, sand and chemicals under pressure to blast new fissures in the rock.

Technology advancements in horizontal drilling and hydraulic fracturing have unleashed new production across the state. Oklahoma oil production almost doubled from 2010 to 2015, although it's declined somewhat as prices have dropped in the past year.

**Fracking links**

Earthquakes linked to hydraulic fracturing aren't new to Oklahoma. In a 2012 workshop sponsored by the Oklahoma Geological Survey, geologists and seismologists discussed the possible causes of a 116-earthquake swarm in Garvin County and a swarm of 10 earthquakes in Canadian County.

A later paper authored by former state seismologist Austin Holland said the Garvin County swarm likely was triggered by hydraulic fracturing. The quakes ranged from 0.6 to 2.9 magnitude over seven days in January 2011. The correlation was strengthened by a temporary shutdown in fracking operations because of bad weather, followed by a decline in seismicity in the area. The quakes continued when operations resumed.

"A time comparison between the number of earthquakes and hydraulic-fracturing injection shows a strong correlation between injection and earthquake occurrence," Holland said in the study published in June 2013 issue of the Bulletin of the Seismological Society of America.

In other countries, some small earthquakes were linked to hydraulic fracturing operations in Blackpool, United Kingdom, in 2011. A 4.6-magnitude earthquake in British Columbia, Canada, last year was traced to nearby hydraulic fracturing.

But in Oklahoma, scientists have linked the higher volumes of wastewater — mostly from oil and gas production in the Mississippi Lime formation of north central Oklahoma and south central Kansas — to increased rates of induced seismicity in Oklahoma and Kansas.

Until 2008, Oklahoma averaged about one earthquake of magnitude-3.0 or greater every year. That number grew to a couple of dozen a year from 2009 to 2012. The state recorded 585 quakes of 3.0 or greater in 2014 and more than 900 in that category in 2015.

The volume of wastewater injected into the Arbuckle formation grew to more than 1.05 billion barrels in 2014, up from 434 million barrels in 2009, according to the Oklahoma Geological Survey. The totals exclude Osage County, which is under federal jurisdiction for wastewater disposal wells.

After two years of lower drilling activity, much of the new development in Oklahoma has moved away from the Mississippi Lime and toward the STACK and SCOOP plays, which produce less water. Operators in those areas are either recycling the produced wastewater or injecting it into other disposal formations, not the deep Arbuckle layer.

**Managing risk**

Regulators in Oklahoma said the risks from earthquakes linked to hydraulic fracturing are more manageable than those linked to disposal well volumes. Companies have to notify regulators when they plan to start hydraulic fracturing at a well, and the operations are monitored in real-time. Pressure, flow rates and sand volumes are logged at each fracturing stage. The biggest hydraulic fracturing jobs can have dozens of fracture stages.


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stage. The biggest hydraulic fracturing jobs can have dozens of fracture stages.

Hydraulic fracturing crews are typically at well sites for short periods of time, from several days to several weeks. Wastewater does flow back to the surface during that time, but the volumes are far below the wastewater volumes that come up during ongoing production.

"The amount of fluid pumped in a fracture treatment is orders of magnitude less than in a disposal operation over time," said a regulatory primer released last year by StatesFirst, a joint project of the Interstate Oil and Gas Compact Commission and the Ground Water Protection Council. "Similarly, the total energy put into the system is relatively small when compared to disposal operations."

Regulators in Canada and Ohio have instituted "traffic light" systems when it comes to hydraulic fracturing linked to earthquakes. Earthquakes at certain magnitudes automatically trigger "red lights" and the suspension of hydraulic fracturing operations.

"As the observation of many hydraulic fracturing operations has shown, induced seismicity potentially related to hydraulic fracturing is extremely rare," the StatesFirst report said. "When it does occur, it is often quickly mitigated, and in the United States has had little direct impact."

The Oklahoma guidelines for hydraulic fracturing and induced seismicity are expected to be similar to those in other places, although the details on what magnitudes would trigger yellow or red lights were still being formulated this week.

**Industry prepares for guidelines**

Chad Warmington, president of the Oklahoma Oil and Gas Association, said his member companies already have internal protocols to watch for seismic events during hydraulic fracturing jobs. Many of the association's members are among the most active drillers in the SCOOP and STACK plays.

Warmington said existing company protocols range from skipping a fracturing stage to pausing operations.

"In the rare instances where seismicity rises above the microseismic level, the goal is to keep it from being felt at the surface," Warmington said. "A protocol the (Corporation) Commission puts in place proactively is a good thing because it matches and probably really fits well with the internal company protocols they use as they detect seismicity in and around the areas in which their production is taking place."

Warmington said earthquakes related to hydraulic fracturing operations are "small, rare and manageable."

"One of the things we're finding with British Columbia and Ohio and other places, is it's pretty much one-off stuff," he said. "Once the completion operation is done, it's done. If you can mitigate it during the operation, that's what our companies are already doing. I think the commission will tell you the disposal-related activity is their primary focus, because that's the biggest driver of seismic activity."

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